



DELAWARE HEALTH AND SOCIAL SERVICES

Division of Public Health

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Radiation Emergencies: Considerations for First Responders & Receivers

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Overview

- ✦ *Radiation as a Tool of Terror*
- ✦ *Types of Radiation Emergencies*
- ✦ *RDD Handbook – First Responders*
- ✦ *Types of Radiation Casualties*
- ✦ *Acute Radiation Injuries*
- ✦ *Medical Management*
- ✦ *Acknowledgements*



The Goal of Terrorism

Terrorist attacks are intended to cause psychological, social and economic disruption, not simply to hurt or kill those in close proximity to the attack.



First Responders & Receivers must consider the possibility of:

- ✦ *Widespread fear and panic*
- ✦ *Blame and mistrust of Authorities*
- ✦ *Mass Sociogenic Illness*
- ✦ *Misattribution of Normal Arousal Response, (fight or flight)*



CBRN Disasters

Terroristic or other intentional acts utilizing chemical, biological, radiological or nuclear technology are referred to as “silent disasters,” with the added dimension of future orientation, such as delayed medical illnesses, risk of birth defects and other genetic impacts on offspring of victims.



Psychosocial Issues

Radiation is a “higher” perceived risk when used as tool of terror:

- ✓ *Source of dread (Hiroshima/Nagasaki/Chernobyl)*
- ✓ *Not observable, unknown to the exposed chronic effect*
- ✓ *Not equitable*
- ✓ *Consequences potentially fatal*
- ✓ *Heritable risk to future generations*



Psychosocial Issues

High risk groups for psychosocial harm:

- ✓ *Infants and children*
- ✓ *Pregnant women*
- ✓ *Parents of young children*
- ✓ *Emergency workers*
- ✓ *Medical Staff*
- ✓ *Ancillary Staff*
- ✓ *Clean-up workers*



Types of Radiation Emergencies

- ✦ *Reactor emergencies (power and research reactors)*
- ✦ *Lost or stolen dangerous sources*
- ✦ *Misuse of dangerous industrial sources*
- ✦ *Accidental medical overexposure*
- ✦ *Transportation emergencies*
- ✦ *Laboratory emergencies*
- ✦ *Malicious use of radioactive materials*
- ✦ *Radioactive contamination of air, food, or water*



Malicious Use Examples

- ✦ *Surreptitious use of device or radioactive material (eg. Po-210 incident, London)*
- ✦ *Detonation of a Radioactive Dispersal Device (RDD or “dirty bomb”)*
- ✦ *Detonation of an Improvised Nuclear Device (IND)*



HANDBOOK FOR RESPONDING TO A RADIOLOGICAL DISPERSAL DEVICE

**Published by the Conference of Radiation Control
Program Directors, Inc.**

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Chairperson, HS-5 Task Force**

**With Funding by the U.S. Centers for Disease
Control and Prevention (CDC)**

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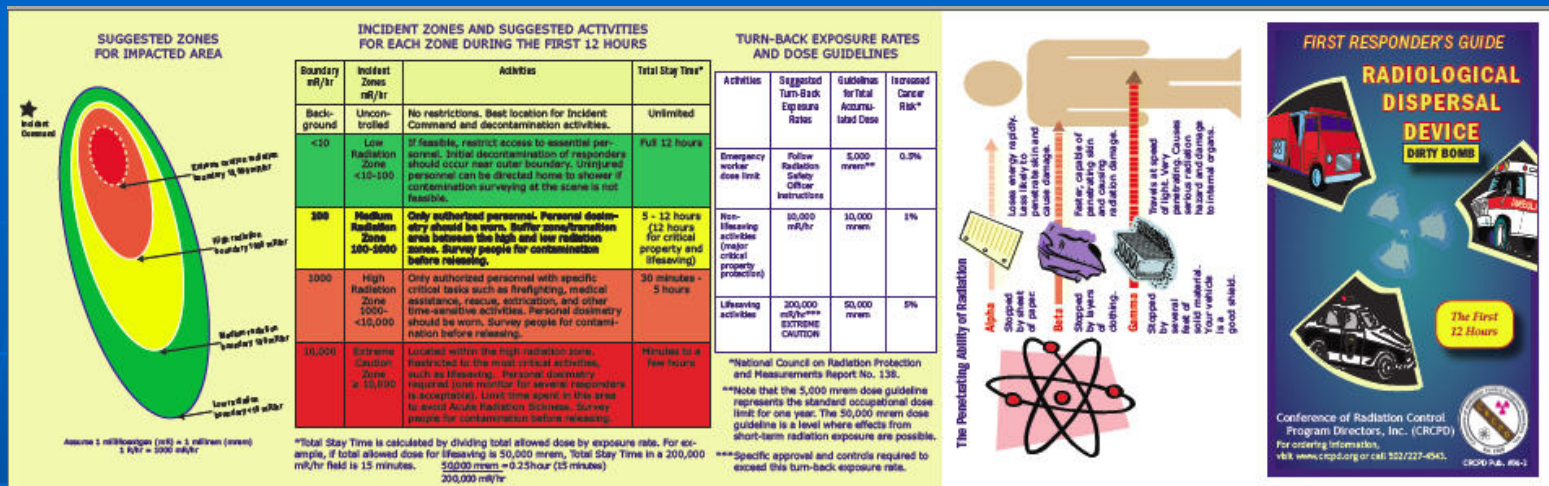
Resources

CDC	Robert Whitcomb
EPA	Bonnie Gitlin
FEMA	John Dixon

TARGET AUDIENCE

**First Responders with
various degrees of
radiological experience**

THE RDD POCKET GUIDE



This guide is a quick reference for State and local first responders. It provides general information for use during the first 12 hours after the detonation of an explosive radiological dispersal device (RDD), also called a *dirty bomb*.

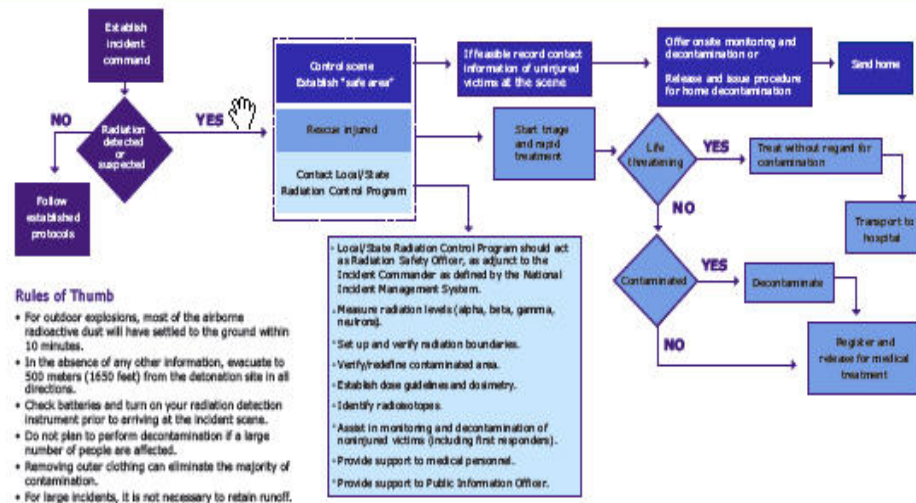
It does not attempt to address all situations, but many concepts can be applied to other types of radiation incidents. A CRCPD RDD companion handbook provides additional information including contacts. The last page of this booklet provides an area to list your contact numbers.

Law enforcement and local/State radiation control staff play a key role in response to an RDD event. It is assumed that an incident command structure has been established and its role is not discussed in this guide.

Contact your State or local radiation control program for recommended policies and procedures or if you have questions.

Radiation usually is measured by field survey instruments in Roentgens per hour (R/hr), milliroentgens per hour (mR/hr), or counts per minute (cpm). It is strongly recommended that you become familiar with your radiation detection equipment prior to responding to an incident. Refer to your instrument user's manual or the CRCPD RDD handbook for additional guidance.

Remember ... Saving Lives is a Priority!



Contacts

Local/State Radiological Lead Agency _____

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This publication was supported in part by funding through purchase order # 205-2004-M-09776 from the Department of Health and Human Services Centers for Disease Control and Prevention.

What is the RDD Handbook?

- Companion to the RDD pocket guide
- Developed for state and local responders who may be called upon to respond to a radiological dispersal device or “dirty bomb”
- Training and Reference tool for Responders



Why did we put it together?

- Ability to deal with radiological incidents at the local and state level varies across the country
- Some states/localities have formal plans to deal with radiological emergencies (especially those with nuclear power plants nearby), while others do not

Scope of the RDD Handbook

- Focuses on the first 12 hours
- Assumes local/state responders will be available within 12 hours (Usually only a “phone call” away)
- See pocket guide for Delaware contact phone numbers

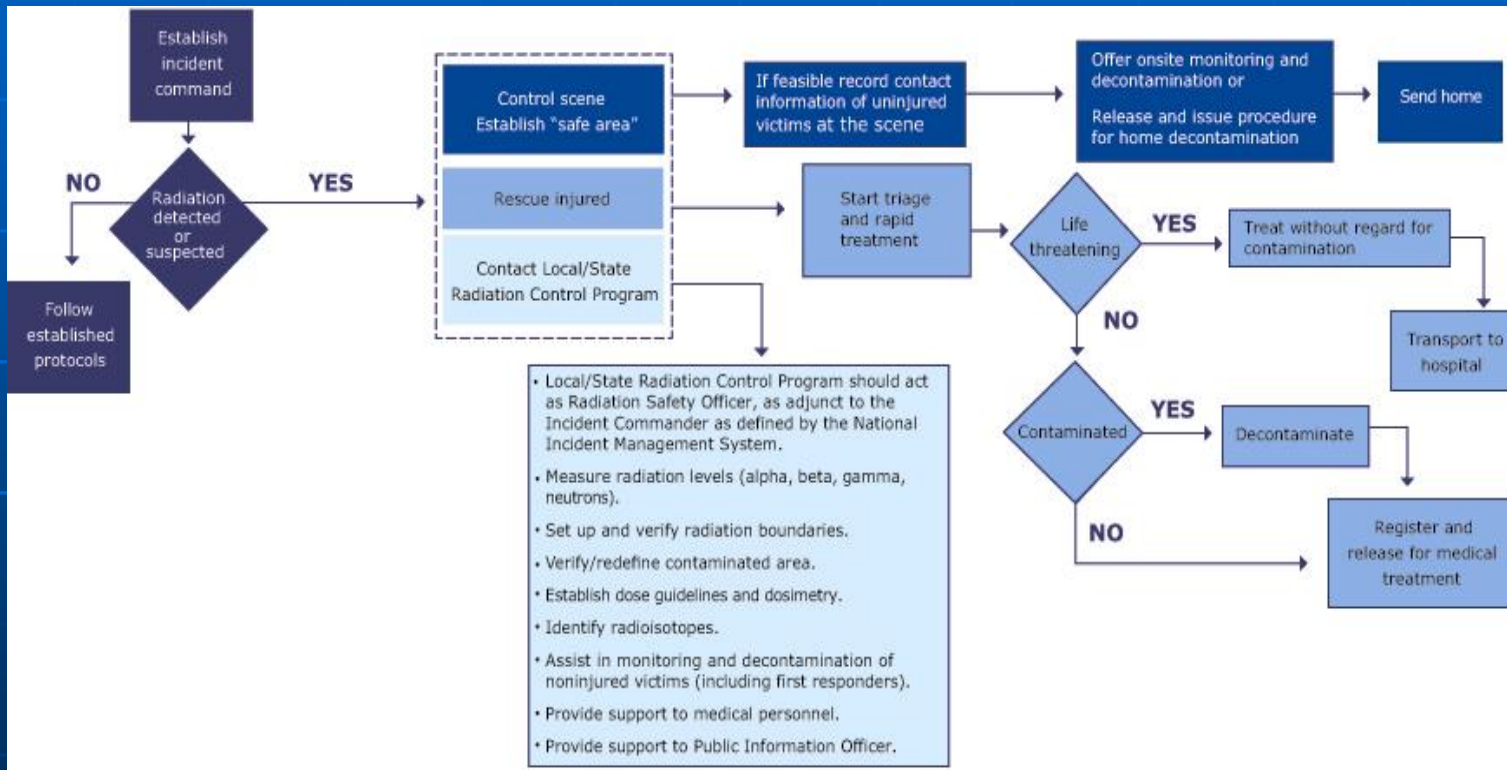


Highlights of the Handbook

- Flowchart
- Definition of Radiation Zones aka the “Bull’s Eye”
- Suggested Activities for each zone
- Turn back exposure rates
- Decontamination Guidelines
- Radiation Survey Guidance/Forms
- Contacts (Local/State/Federal)

FLOWCHART OF ACTIONS

Remember ... Saving Lives is a Priority!

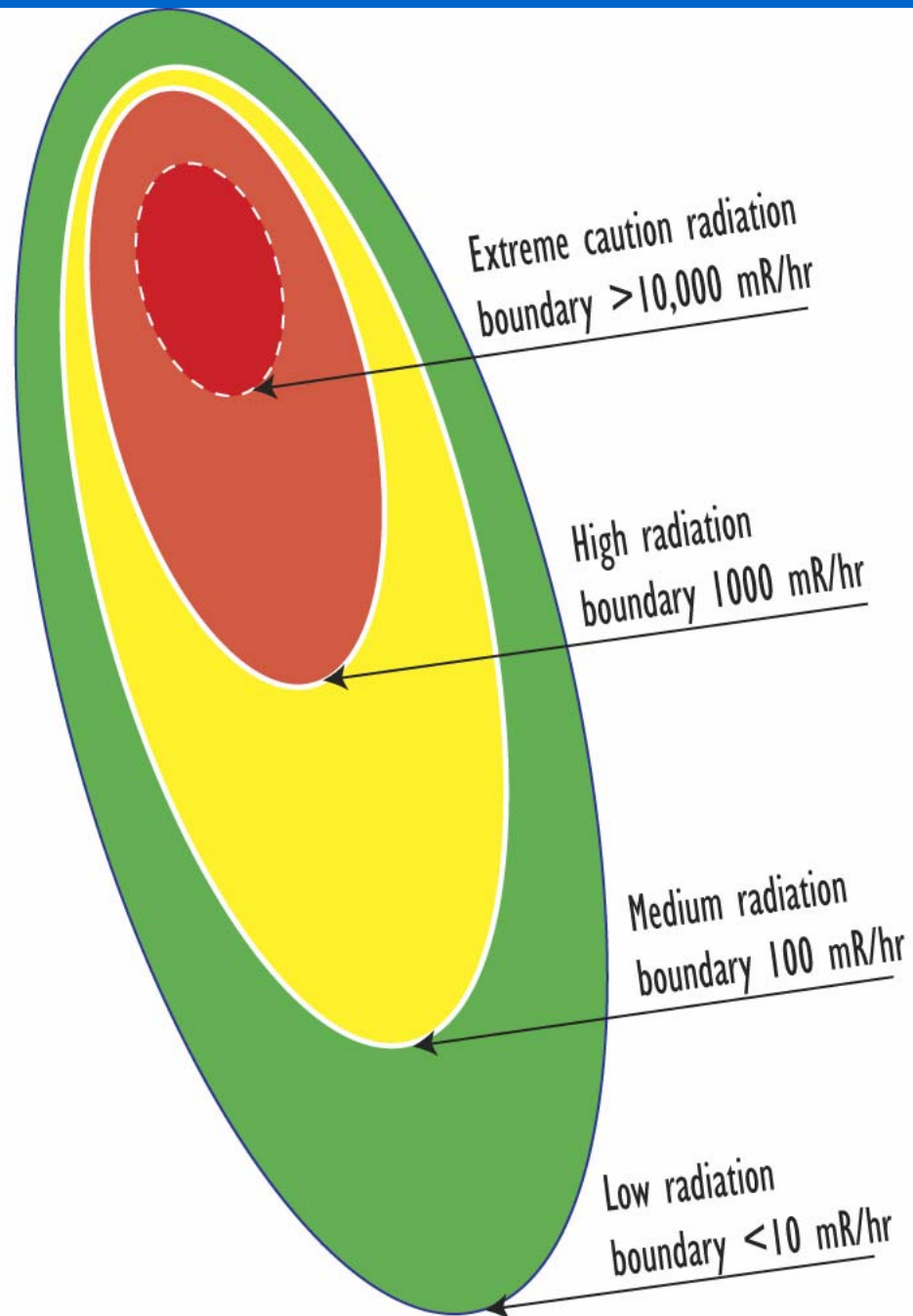


The Flowchart

Contact Local/State Radiation Control Program

- Measure radiation levels (alpha, beta, gamma)
- Set up and verify radiation boundaries
- Verify/redefine contaminated area
- Establish dose guidelines and dosimetry
- Identify radioisotopes
- Assist in monitoring and decontamination of victims (including first responders)
- Provide support to medical personnel
- Provide support to Public Information Officer

★
Incident
Command



INCIDENT ZONES AND SUGGESTED ACTIVITIES FOR EACH ZONE DURING THE FIRST 12 HOURS

Boundary mR/hr	Incident Zones mR/hr	Activities	Total Stay Time*
Background	Uncontrolled	No restrictions. Best location for Incident Command and decontamination activities.	Unlimited
<10	Low- Radiation Zone <10-100	If feasible, restrict access to essential personnel. Initial decontamination of responders should occur near outer boundary. Uninjured personnel can be directed home to shower if contamination surveying at the scene is not feasible.	Full 12 hours
100	Medium- Radiation Zone 100-1000	Only authorized personnel. Personal dosimetry should be worn. Buffer zone/transition area between the High and Low radiation zones. Survey people for contamination before releasing.	5 - 12 hours (12 hours for critical property and life saving)
1000	High- Radiation Zone 1000- <10,000	Only authorized personnel with specific critical tasks such as fire fighting, medical assistance, rescue, extrication, and other time sensitive activities. Personal dosimetry should be worn. Survey people for contamination before releasing.	30 minutes - 5 hours
10,000	Extreme Caution Zone ? ≥ 10,000	Located within the High radiation zone. Restricted to the most critical activities, such as lifesaving. Personal dosimetry required (one monitor for several responders is acceptable). Limit time spent in this area to avoid Acute Radiation Sickness. Survey people for contamination before releasing.	Minutes to a few hours

*Total Stay Time is calculated by dividing total allowed dose by exposure rate. For example, if total allowed dose for lifesaving is 50,000 mRem, Total Stay Time in a 200,000 mRem/hr field is 15 minutes.

DECONTAMINATION GUIDELINES

- If there is a large population to be evacuated in the *low radiation zone* (<10-100 mR/hr) self decontamination at home may be advised
- Use portal monitors if available
- If event is small and adequate resources are available, use more restrictive guidelines
- If individuals do not require immediate medical attention - decontaminate on site or allow to go home to shower (instruction sheet provided)

DECONTAMINATION GUIDELINES

Suggested Release Levels (pancake GM at 1 inch from source)

- **Up to 1,000 cpm - allow individuals to leave; Instruct people to go home and shower**
- **If event is large and adequate decontamination resources are NOT available - release level up to 10,000 cpm; Instruct people to go home and shower**
- **If > 10,000 cpm - send to designated decontamination area**
- **If >100,000 cpm - Likely to have internal contamination - Priority for follow-up for internal contamination**

Types of Radiation Casualties

- ✦ Conventional injury, such as thermal burns, blast injuries, mass panic actions
- ✦ External exposure:
 - ✓ *Whole body*
 - ✓ *Partial or localized*
- ✦ Contamination:
 - ✓ *External or internal*
- ✦ Combined injury = conventional injury + radiation exposure and/or contamination



Factors affecting Severity of Radiation Casualties

- ✦ **Type of Radiation Emergency:**
 - ✓ *Detonation*
 - ✓ *Radionuclide(s) involved*
- ✦ **Route of Exposure:**
 - ✓ *Inhalation, ingestion*
- ✦ **Magnitude of Exposure experienced**
- ✦ **Magnitude of Dose received**



Radiation Safety Principles

- ✦ *Limit Exposure, Limit Dose*
- ✦ *The Big Three:*
 1. *Time*
 2. *Distance*
 3. *Shielding*
- ✦ *Radiation intensity drops off quickly with distance*



Radiation Exposure

✧ **External:**

- Radiation source is **outside** the body
- Most risk from x or gamma rays
(able to penetrate into body)

✧ **Internal:**

- Radiation source is **inside** the body
- Most risk from alpha and beta particles
(deposit energy over short distance)



Contamination

- ✦ *The deposition of unwanted radioactive material on the surfaces of structures, areas, objects, or people.*
 - ✓ **External** – *such as deposition of airborne dust on persons' clothing or hair*
 - ✓ **Internal** – *such as inhalation of airborne dust, or ingestion of food contaminated with radioactive material.*



Medical Management of Radiation Casualties

- ✦ *Treat and stabilize life-threatening injuries*
- ✦ *Prevent/minimize internal contamination*
- ✦ *Assess external contamination and decon*
- ✦ *Contain contamination to treatment area*
- ✦ *Minimize external contamination of medical personnel*
- ✦ *Assess local radiation injuries/burns*
- ✦ *Provide supportive care and/or radio-protective drugs, as indicated*



Ionizing Radiation Effects

▲ Deterministic

- ✓ *Severity is a function of dose*
- ✓ *Threshold exists*
- ✓ *Examples: Acute Radiation Syndrome (ARS), acute localized injury (burns), mental and growth retardation in offspring, cataract formation*

▲ Stochastic

- ✓ *Risk is a function of dose*
- ✓ *No threshold*
- ✓ *Example: radiation-induced cancer*



Acute Localized Radiation Injury

- ✦ *Prodromal stage: 0-48 hrs*
 - ✓ *Transient erythema*
 - ✓ *Migratory parathesias*
 - ✓ *Conjunctivitis*
- ✦ *Latent stage: Hours - 21 days*
- ✦ *Manifest Illness: Hours – 30 days*
 - ✓ *Erythema, bronzing, blistering, desquamation, vascular and cutaneous damage, poor wound healing, infections, necrosis above 5000 Rads (cGy)*
- ✦ *Death or Recovery: Hours – 60 days*



Acute Localized Radiation Injury

- ✦ *Problems in medical management:*
 - ✓ *Wounds evolve very slowly*
 - ✓ *Healing is very prolonged*
 - ✓ *Lesions can be intensely painful*
 - ✓ *Healed epidermis is fragile, and easily traumatized, eg. sweat, heat*
 - ✓ *Combined injury may worsen prognosis*



Acute Radiation Syndrome

People exposed to radiation will get acute radiation syndrome ONLY if:

- ✓ *Radiation dose is sufficiently high*
- ✓ *Type of radiation is penetrating*
- ✓ *Person's entire body or most of it, received dose, AND*
- ✓ *Radiation was received in a short time, usually within minutes.*



Acute Radiation Syndrome

Threshold (LD 5, 5% lethal dose)

Exposure to 200 - 225 Rads (cGy)

Threshold (LD 50, median lethal dose)

Exposure to 400 - 450 Rads (cGy)



Acute Radiation Syndrome

- ✦ *Prodromal stage: 0 – 48 hours*
 - ✓ *Nausea, vomiting, diarrhea (NVD)*
 - ✓ *Anorexia, low-grade fever, lymphopenia*
- ✦ *Latent stage: hours – 21 days*
 - ✓ *Symptoms absent or diminished*
- ✦ *Manifest Illness stage: hours – 30 days*
 - ✓ *Hematopoietic, GI tract, cutaneous, epilation, respiratory, cardiovascular, cerebrovascular/CNS*
- ✦ *Death or Recovery: hours – 60 days*



Radio-sensitivity of Cells

- ✦ *Mature lymphocytes*
- ✦ *Erythroblasts*
- ✦ *Certain spermatogonia*
- ✦ *Granulosa cells*
- ✦ *Myeloblasts*
- ✦ *Intestinal crypt cells*
- ✦ *Basal cells*
- ✦ *Endothelial cells ...*



Diagnosis of ARS

- ✦ *CBC with diff every 6 hours, for at least 48 hours*
- ✦ *Absolute Lymphocyte Count (ALC)*
- ✦ *Routine medical and trauma labs*
- ✦ *Serum amylase*
- ✦ *Urine for radioassay*
- ✦ *Begin 24-hr collection of urine and feces for radioassays*



Supportive Care in the ED

- *Antimicrobials*
- *Antiemetics*
- *Anxiolytics/sedatives*
- *Antidiarrheals*
- *Fluids*
- *Electrolytes*
- *Analgesics*
- *Topical burn therapy*
- *Psychosocial/pastoral care*



Treatment after the ED

- ✦ *Bacterial, viral and fungal infection prophylaxis – and later, infection control*
- ✦ *Surgical intervention – first 36 hours, before wound healing capability fails*
- ✦ *Stimulation of hematopoietic system – cytokines or colony stimulating factors, as soon as dose assessed as > 200 Rads (cGy)*
- ✦ *Transfusions – platelets, RBCs*



Acknowledgements

- ✦ *Jonathan M. Links, PhD, Johns Hopkins Bloomberg School of Public Health*
- ✦ *Steven M. Crimando, MA, BCETS, New Jersey Division of Mental Health Services – Disaster and Terrorism Branch*
- ✦ *Emily Falone, Section Chief, Delaware Public Health Preparedness Section*
- ✦ *Conference of Radiation Control Program Directors (www.crcpd.org)*



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- ✦ www.orise.orau.gov/reacts
- ✦ www.iaea.org
- ✦ <http://REMM.NLM.GOV>
- ✦ www.cdc.gov
- ✦ www.nrc.gov
- ✦ www.crcpd.org



Thanks for your attention !

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